DOCUMENT RESUME

ED 202 461 — IR 009 333

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TITLE Computer Assisted Learning in U.S. Secondary/Elementary Schools.
INSTITUTION Association for Computing Machinery, New York, N.Y.
PUB DATE Jul 80
NOTE 50p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; Computer Oriented Programs; *Elementary Secondary Education; *Microcomputers; *National Surveys; *Prediction; Problems; Sampling; Simulation; Tables (Data); Use Studies

ABSTRACT

A sample of 974 school districts was surveyed by mail to determine the current and projected use of computers in United States public secondary/elementary schools, with special reference to computer assisted learning. Returned questionnaires provided a 62.3 percent response rate, and were balanced both geographically and by urban/rural distribution. Analyses indicated that 90 percent of the districts were currently using the computer, with projections to 94 percent by 1985. Instructional usage was reported by 74 percent, with projections to 87 percent by 1985. A total of 54 percent of the districts reported use of the computer for computer assisted learning, with projections to 74 percent by 1985. Major usage is in secondary schools for drill and practice in mathematics, natural sciences, business, and language arts. Projections for 1980-85, however, indicate greater usage in the social sciences at the secondary levels, as well as growth at the elementary school levels in all subject areas, and shifts to tutorials and simulations with microcomputers as the delivery systems. Major impediments to usage were identified as financial, lack of knowledge about computer assisted learning and computers in general, faculty attitudes, and the need for more and better computer assisted learning modules. (Author/BK)

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COMPUTER ASSISTED LEARNING IN U. S. SECONDARY/ELEMENTARY SCHOOLS

A Report by

The Task Force on Computer Assisted Learning
Subcommittee on Computing in the Secondary/Elementary Schools
Association for Computing Machinery

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IR009333

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Computer Assisted Learning in U. S. Secondary/Elementary Schools

ABSTRACT

This study assessed the current and projected use of computers in U. S. public secondary/elementary schools with special reference to computer assisted learning. A sample of 974 school districts was selected to represent the total population of U. S. public school districts. A mailed questionnaire provided a 62.3% response, balanced as to geographic and urban/rural distribution.

Analyses indicated 90% of the districts were currently using the computer, with projections to 94% by 1985. Instructional usage was reported by 74%, with projections to 87% by 1985.

A total of 54% of the districts reported use of the computer for computer assisted learning, with projections to 74% by 1985. Major usage is in the secondary schools in the areas of Mathematics, Natural Sciences, Business and Language Arts. Most usage is drill and practice. However, projections for 1980-85 indicated greater usage in the secondary schools in the Social Sciences as well as growth at the elementary school level. Shifts to tutorials and simulations were predicted, with microcomputers as delivery systems. Major impediments to usage were identified as financial, lack of knowledge about computer assisted learning and computers in general, attitudes of faculty, and need for more and better computer assisted learning modules.

Computer Assisted Learning In
U. S. Secondary/Elementary Schools

INTRODUCTION

Computer Assisted Learning

Computer assisted learning represents the use of the computer in one of its most advanced forms, i.e., to provide content instruction in the form of simulations, games, tutorials and/or drill and practice. Within these modes, computer assisted learning takes several forms. The adjunct type (22) represents short (½ to 2 hour) programs used to supplement or illustrate concepts usually also discussed in the regular classroom. Primary computer assisted learning (10) on the other hand, represents materials which provide instruction of a substitute or stand-alone variety, where a majority of the instruction is handled by the computer. In many discussions worldwide, primary computer assisted learning is being evaluated as a part of distance learning -- a term used in many countries to describe efforts to provide education to large groups over broad distances. Distance learning typically encompasses the use of printed material and educational technology including radio, television, electronic conferencing and mail as well as computers. It is used in conjunction with the more traditional methods such as correspondence courses (21).

Another distinction within computer assisted learning is between programs which are mainly concerned with text display and those which make extensive use of graphics, color, voice output, and the like.

Why use computer assisted learning? Perhaps the most widely-accepted value of computer assisted learning is that it involves the individual actively in the learning process. It is impossible for the student to be totally passive in good computer-based learning situations, and this very activity and involvement facilitates learning (26). Another much touted value is the

ability of learners to proceed at their own pace, which has strong implications for both the slow learner and the gifted person.

Reinforcement of learning in computer assisted learning is immediate and systematized, which should result in more effective learning, according to theories of instruction. In addition, the computer in a simulation mode permits students to explore time and space, to create artificial worlds, to mix explosive chemicals together in a simulated laboratory without destroying themselves and the lab, and permits the investigation of complex problems using instruments and methodology which would be excessively costly or not possible at all without the computer.

The use of computers in learning frees faculty members to devote more time to the personal, humane considerations of their students. Time thus spent with students has been found in a nationwide study of university faculty and students (9) to be the most important factor, in student's opinions, in the development of their creative abilities. Thus, such use of the computer should result in providing an educational environment in which individuals learn more, and in which their potential for innovative and creative professional work is more fully developed.

The disadvantages of using computers in the learning process can be summarized into three main categories. In order of importance, these are: 1) the requirement for faculty to move from accepted and working methods to a new and relatively untried method in which most individuals have little expertise, and in which considerable concern and antipathy are aroused due to its technological base; 2) the primitive state-of-the-art in which a diversity of computing hardware and computer assisted learning languages compete with little apparent coordination from professionals in the educational world -- in which much of the available computer based learning materials are poorly constructed, undocumented, and able to run only on select computers for which they were

written -- and in which there are relatively few "experts" to whom users can turn for assistance; and 3) the cost of hardware, course materials (courseware), and individuals to help implement the process.

Computer assisted learning was initiated on an experimental basis in higher education in the United States in the late 50's. Early activities helped to provide the needed expertise in understanding the capabilities of this new learning medium. Currently, the majority of work is concentrated in four major geographical areas -- the United States, the United Kingdom, Canada and Japan (21).

Computer assisted learning, by 1980, has now been evaluated in a number of different contexts in reasonably well controlled studies. Results show consistent findings, as follows: 1) the use of Computer Assisted Learning either improved learning or showed no differences when compared to the traditional classroom approach (1, 16, 22, 25, 27, 29, 32, 34); 2) the use of computer assisted learning reduced learning time when compared to the regular classroom (11, 16, 22, 25, 31, 32, 34); 3) the use of computer assisted learning improved student attitudes toward the use of computers in the learning situation (11, 22, 25, 27, 32, 34); and 4) the development of computer assisted learning courseware following specified guidelines can result in portability, as well as acceptance and use by other faculty (8, 14, 23, 26).

Costs have probably been the greatest single deterrent to the use of computer assisted learning in the educational setting, especially at the secondary/elementary level. However, with the commercial availability of the microcomputer at an average cost of $3,000 each to provide adequate support for computer assisted learning -- offering graphics, color, and voice response -- computing hardware is now within reach in most educational settings. Although computer materials are still costly to develop, a variety of computer assisted learning materials for microcomputers and minicomputers are available at modest

or no cost from such sources as CONDUIT (University of Iowa) (14), "The ABC's of CAI" program at California State University, Fresno (8) and the like. Computer vendors are also making available program libraries appropriate for both secondary schools and higher education.

In addition to these cost considerations, cost avoidance should also be examined. Traditional instructional costs increased by 13% per year during 1974-77, while computer assisted learning costs decreased at 5% per year, coupled with a 10% improvement in computer assisted learning performance (28).

Finally, if our goals are to improve the learning situation, then costs must be set beside a qualitative assessment of educational change to answer the question -- is it worth the cost? (26).

What about the future? Experts (2, 4, 6, 7, 20, 24, 28) agree that between 1980 and 1990, cost reductions due to mass production and consumption for home entertainment and learning will permit cost/effective uses of computer assisted learning in both the traditional classroom and in other settings. This cost/effective technology will include stand alone computers with voice input and response, interactive television, video-disk systems, and satellite communications. One major "futurist" (28) envisions an international network of learning centers with computer assisted learning as the main delivery system. He forsees these centers as a part of the private sector, providing direct learning experience for individuals, or providing sales of developed materials to educational institutions.

Secondary/Elementary School Perspective

Computers were relatively unknown in secondary/elementary education for a number of years after their introduction into the higher education setting. In the early sixties, Goodlad, O'Toole & Tyler (18) estimated that a maximum of 300 secondary schools were using the computer for instructional applications. Somewhat later, in 1966, Bangs and Hillestad (3) reported 1.7% usage of the computer for instructional purposes in a survey of 11,000 public U. S. secondary schools.

A comprehensive study conducted in 1970 by the American Institute for Research on behalf of the National Science Foundation encompassed all 123,033 public secondary schools in the United States (15). The questionnaire used was quite lengthy, and only a 16% response was obtained. To improve the response rate and thus provide more reliable data concerning use or non-use of the computer in relation to administrative and instructional applications, a post-card follow-up questionnaire was employed which resulted in an additional 38% response, bringing the total response rate to approximately 54%.

The results, for 1970, were quite startling. Over 34% of the secondary schools were using the computer, while 13% were using it in support of instruction. The schools using the computer tended to cluster around metropolitan areas on the east and west costs. Most computer usage was through equipment leased by the school, or through time purchased on outside equipment.

Predominant use of the computer in instruction was in the Math, Science, Business and Data Processing areas in the secondary schools, with slight use in the junior high schools. The predominant instructional uses were problem solving, acquiring EDP skills, and guidance and counseling applications. FORTRAN and BASIC were the two most popular languages. Problems identified for future use included funding, space, faculty training, and a need for more information.

For the first time, computer assisted learning was identified as a separate instructional usage in this study. Its usage fell just below that of guidance and counseling applications, and its usage pattern was similar to that of the other instructional applications.

Since 1970 no formal assessment was found of the overall use of the computer in U. S. secondary/elementary schools for instructional purposes in general or for computer assisted learning in particular. That such usage has

been increasing appeared evident from reports of large scale computer assisted learning projects such as the Chicago City Schools Project (10), the Los Angeles Project (30), and the PLATO Champagne-Urbana Project (33).

The Chicago City Schools Project began in 1971 and is continuing today, reaching over 12,000 fourth through eighth grade children in the inner city schools. Using computer assisted learning to provide tutorials in basic reading and arithmetic, the project has had significant results. As an example, the average increase in reading ability in the schools was 5.4 months per pupil for each ten months of regular classroom instruction. Using computer assisted learning, the average rose to 9.0 months improvement for eight months of instruction.

The Los Angeles Project is similar to the Chicago City Schools Project in that both involve the use of Suppe's mathematics and reading materials with elementary level inner-city school children. In the on-going controlled evaluation of this project by the Educational Testing Service, Ragosta (30) has indicated that after four years of study, the findings to date appear most favorable in regard to the mathematics program, with the other programs showing some effects.

The use of PLATO mathematics and reading materials in several elementary schools in the Champagne-Urbana area was also evaluated under controlled conditions by the Educational Testing Service. Swinton (33) indicated that such usage, which was incremental to regular classroom experiences, was highly significant in the area of mathematics. Conversely, the reading materials produced negative results. Examination of relevant variables indicated that the differences were larely attributable to the superior quality of the PLATO mathematics modules and the successful inclusion of the mathematics teachers as a part of the overall learning program.

Another large scale computer assisted learning project (bilingual instruction) has been reported in the Dallas Public Schools (12). The Minnesota schools have provided some further data on instructional computer usage in general, in that the Minnesota Educational Computing Consortium (MECC) reported in 1979 that in Minnesota, 75% of the state school districts had access to a computer (13).

Further evidence for increased instructional computer usage came recently from Henderson (19), who stated:

> "The elementary teacher is no longer excluded when we talk about the computer as an instructional tool. The students in grades 1-8 are very much aware of computers and can become motivated in using this technology in their classroom" (p. 41).

Henderson recommended computer literacy training for all elementary and secondary teachers, plus specific training in computer assisted learning.

Building on this same theme, Blaschke (5) surveyed 1,200 secondary school principals and found strong support for the use of the microcomputer in both the secondary and elementary schools. He stated:

> "The major bottleneck limiting the widespread and effective use of microcomputers in elementary and secondary schools is the availability of quality software which meets high priority user needs" (p. 26).

Purpose of the Study

The primary purpose of the study was to assess the current and projected use of the computer in U. S. public secondary and elementary schools, with special emphasis on the use of the computer in computer assisted learning. A part of this overall assessment was to determine factors impeding the use of

computer assisted learning in the nation's secondary/elementary schools, so that guidelines to facilitate usage could be established by professional, educational, and governmental agencies in general, and the Association for Computing Machinery's Subcommittee on Computing in the Secondary/Elementary Schools in particular.

METHOD

Selection of Sample

The sample was selected to approximate the total population of public secondary/elementary schools in the United States. To achieve this, a sample of 974 public school districts throughout the U. S. was selected, controlling for the variables of geographic and urban/rural distribution. Two different methods were employed.

Method I attempted to control for geographic distribution. First, 10 school districts were selected from each of the 50 states, using Patterson's American Education as the source (17). Within each state, half of the districts were selected from the northern half of the state, and half from the southern, with as much geographic spread as possible. To balance urban/rural mix as much as possible, half of the districts chosen from each state were selected from the largest metropolitan areas, while half were chosen from small population areas.

Following the completion of sample selection under Method I, Method II was employed, which attempted to provide overall population balance and urban/rural distribution. Under this method, 474 school districts were selected throughout the United States, with the number selected per state based on that state's proportion of the total U. S. population. Selection of school districts within each state then followed the guidelines identified for Method I, with emphasis on a balanced geographic and urban/rural distribution.

Measuring Instrument

A 34 item questionnaire was developed for use with items pertaining to current and projected use of the computer, type of usage, class levels of instructional usage, academic fields in which used, etc. Several write-in items were included which permitted the districts to indicate the obstacles needed to be overcome for computer assisted learning to be effectively used in that district, as well as the activities which the computer assisted learning Task Force might undertake in the future to be of maximal assistance.

A final section of the questionnaire permitted districts to request specific computer assisted learning information items and reports to be sent to them. In addition, respondents could request a copy of the final report of the study, and could have their name placed on a master list for further computer assisted learning publications and materials from ACM, the Task Force, interested vendors, etc.

Procedure

In mid-March, 1980, the questionnaire, a two page summary of information about microcomputers and a two page summary of information about computer assisted learning and its educational effectiveness was mailed along with a personally typed letter (signed by the Task Force co-chairs) and a stamped self-addressed envelope to the superintendents of the school districts previously identified. The superintendents were encouraged to identify a person on their staff to complete and return the questionnaire, and to serve as a coordinator of computer assisted learning information within the district in the future.

Approximately two weeks later, a post-card follow-up was mailed to all superintendents. A second follow-up was then conducted two weeks after the post-card mailing. This final follow-up consisted of a personally typed and signed letter to those superintendents from whom no reply had yet been received. The mailing also included a second copy of the questionnaire.

Data from the completed questionnaires were entered into the CSU, Fresno computer. Item responses were tallied and percentages developed overall, by urban/rural mix and by geographic area of the U. S. The write-in responses to items were categorized by the research staff and frequency tables developed. Finally, chi square analyses were computed among all items.

RESULTS

Characteristics of the Responding Sample

Number and percentages of returns, by urban/rural mix and by geographic area are given in Table 1. As may be noted, both geographic and urban/rural distribution needs appeared to have been met. The 607 responding districts, representing a 62.3% overall return was considered as providing reliable data for the intended purposes.

Computer Usage in U. S. Secondary/Elementary Schools

Overall Computer Usage

Tables 2-5 provide data relative to the overall current use of computers in U. S. public secondary/elementary schools. As may be noted, approximately 90% of all school districts responding are now using the computer, and 74% of all districts are using computers in support of the instructional process. Most computers are leased or owned by the districts, and large computers are more in evidence than are minis or micros, which are about equal in popularity. Some districts have use of more than one computer. The most popular applications in order of usage are the teaching of computer languages, computer assisted learning, data processing applications (the computer as a subject of study), using the computer as a computational aid, and using it for guidance and counseling applications.

Table 1

Characteristics of Responding Sample

	Far West		Midwest		South		Northeast		Total	
	N	%	N	%	N	%	N	%	N	%
Urban	43		68		66		38		215	35.4%
Rural	92		103		116		73		384	63.3%
Unclassified	1		4		2		1		8	1.3%
Total	136	22.4%	175	28.8%	184	30.3%	112	18.5%	607	100.0%

Notes:

1) Total responses include eight school districts which did not provide sufficient data to permit urban/rural classification.

2) Urban/rural classification was based on an overall classification of the metropolitan area surrounding the school district. Urban represented those school districts in metropolitan areas greater than 50,000 population; rural represented those in metropolitan areas less than 50,000 population.

Table 2

Current Computer Usage

	N	%
Both instructional and administrative usage	356	59.7%
Administrative usage only	91	15.3%
Instructional support only	88	14.8%
No computer usage	61	10.2%

Table 3

Size of Computers Currently Used*

	N	%
Large computer	349	57.5%
Minicomputer	252	41.5%
Microcomputer	238	39.2%

* Multiple responses permitted

Table 4

Current Computer Hardware Financial Arrangements *

	N	%
Leased or owned by District	436	71.8%
Time purchased from another educational institution	141	23.2%
Time purchased from private vendor	70	11.5%
Other (purchased time from city, county, etc.)	35	5.8%

* Multiple responses permitted

Table 5

Current Types of Instructional Usage*

	N	%
Teaching computer languages	353	58.2%
Computer assisted learning	330	54.4%
Data processing applications	313	51.6%
Computational Aid	227	37.4%
Guidance and counseling	213	35.1%
No instructional use	84	13.8%

* Multiple responses permitted

Current Use of Computer Assisted Learning

Tables 6-18 present data relevant to the current use of computer assisted learning in the nation's secondary/elementary schools. Table 5 had indicated computer assisted learning to be in use in over 54% of the responding institutions. These tables then amplify the meaning of this statistic.

Predominant use of computer assisted learning is currently for drill and practice, although simulations are receiving a good deal of usage. Most computer assisted learning courseware programs in use are written in BASIC, and have either been supplied by the computing hardware vendor or have been written within the school district.

Predominant computer assisted learning usage is occurring at the high school level with Mathematics, Natural Science, Business and Language Arts the principal academic usage areas. Overall, faculty and students are positive in their views of computer assisted learning as an instructional tool, and over three-fourths of the districts indicated faculty are interested in developing new computer assisted learning programs.

Projected Computer Usage Overall, 1980-85

Tables 19-28 present data relative to the projected overall use of computers in the U. S. public secondary/elementary schools for the period 1980-85, as reported in the responses to our survey . As may be noted, approximately 94% of the secondary/elementary school districts anticipate using the computer, with about 87% using such equipment for instructional support. Usage will vary among large, mini, and microcomputers, with the majority of equipment purchased by the districts.

Types of instructional usage are projected to continue as in previous years with computer assisted learning assuming greater significance -- 74% of the districts indicate usage of computer assisted learning between 1980 and 1985. Tutorials are projected to assume greater usage with drill and practice assuming less. The majority of computer assisted learning courseware is

Table 6

Current Computer Assisted Learning Usage by Types*

	N	%
Drill and practice	298	49.1%
Games	277	45.6%
Simulations	268	44.2%
Tutorials	228	37.6%

* Multiple responses permitted

Table 7

Current Heaviest Type Computer Assisted Learning Usage

	N	%
Drill and practice	157	52.3%
Simulations	69	23.0%
Games	45	15.0%
Tutorials	29	9.7%

Table 8

Current Computer Assisted Learning Courseware Sources*

	N	%
Supplied by hardware vendor	263	43.3%
Written in district	245	40.4%
Acquired from sources other than hardware vendor or faculty	158	26.0%
Acquired from other faculty	99	16.3%

* Multiple responses permitted

Table 9

Current Primary Computer Assisted Learning Courseware Source

	N	%
Supplied by hardware vendor	150	45.7%
Written in district	101	30.8%
Acquired from sources other than hardware vendor or faculty	57	17.4%
Acquired from other faculty	20	6.1%

Table 10

Current Computer Assisted Learning Courseware
by Computer Language *

	N	%
BASIC	314	51.7%
FORTRAN	111	18.3%
Other (COBOL, Assembler, RPG, etc.)	29	4.8%
PASCAL	13	2.1%

* Multiple responses permitted

Table 11

Primary Computer Language for
Computer Assisted Learning Courseware

	N	%
BASIC	285	87.4%
FORTRAN	26	8.0%
Other (COBOL, RPG, etc.)	14	4.3%
PASCAL	1	.3%

Table 12

Current Computer Assisted Learning Usage by Academic Areas*

	N	%
Math	330	54.4%
Natural Science (Physics, Chemistry, Biology, etc.)	158	26.0%
Business	158	26.0%
English, Reading and Language Arts	98	16.0%
Social Science (Psychology, Geography, etc.)	77	12.7%
Other (Computer Science, Agriculture, Foreign Languages, etc.)	64	10.5%

* Multiple responses permitted

Table 13

Academic Area of Highest Current Computer Assisted Learning Usage

	N	%
Math	234	77.2%
Business	25	8.3%
Other (English, Reading and Language Arts, etc.)	25	8.3%
Natural Science (Physics, Chemistry, Biology, etc.)	17	5.6%
Social Science (Psychology, Geography, etc.)	2	0.7%

Table 14

Current Computer Assisted Learning Usage by Grade Level*

	N	%
10-12	310	51.1%
7-9	239	39.4%
K-6	168	27.7%

* Multiple responses permitted

Table 15

Largest Current Computer Assisted Learning Usage by Grade Level

	N	%
10-12	225	70.1%
K-6	49	15.3%
7-9	47	14.6%

Table 16

Current Faculty View of Computer Assisted Learning

	N	%
Helpful	193	56.9%
Very Helpful	103	30.4%
(At Best) Acceptable	39	11.5%
Not Helpful	4	1.2%

Table 17

Current Student View of Computer Assisted Learning

	N	%
Great	180	53.3%
Interesting	149	44.1%
(At Best) Acceptable	9	2.7%
Not Helpful	0	0 %

Table 18

Faculty Interest in Writing
Computer Assisted Learning Materials

	N	%
Those interested	359	79.2%
Those not interested	94	20.8%

Table 19

Projected Computer Usage, 1980-85

	N	%
Both instructional and administrative usage	452	77.8%
Instructional support only	53	9.1%
Administrative use only	38	6.5%
No computer usage	38	6.5%

Table 20

Projected Size of Computers to be Used, 1980-85*

	N	%
Large Computer	340	56.0%
Microcomputer	313	51.6%
Minicomputer	279	46.0%

* Multiple responses permitte

Table 21

Projected Computer Hardware Financial Arrangements, 1980-85*

	N	%
Purchased by District	420	69.2%
Leased by District	133	21.9%
Time purchased from another educational institution	118	19.4%
Time purchased from private vendor	44	7.2%
Other (purchased time from city, county, etc.)	28	4.6%

* Multiple responses permitted

Table 22

Projected Types of Instructional Usage, 1980-85*

	N	%
Computer assisted learning	447	73.6%
Teaching computer languages	420	69.2%
Data processing applications	399	65.7%
Guidance and counseling	330	54.4%
Computational aid	300	49.4%
No projected instructional usage	29	4.8%

* Multiple responses permitted

Table 23

Projected Computer Assisted Learning Usage by Types, 1980-85*

	N	%
Drill and practice	430	70.8%
Tutorials	411	67.7%
Simulations	391	64.4%
Games	331	54.5%

* Multiple responses permitted

Table 24

Projected Heaviest Type of Computer Assisted Learning Usage, 1980-85

	N	%
Drill and practice	130	38.8%
Tutorials	111	33.1%
Simulations	90	26.9%
Games	4	1.2%

Table 25

Projected Computer Assisted Learning Courseware Sources, 1980-85*

	N	%
Obtained from outside sources	396	65.2%
Written in District	265	43.7%

* Multiple responses permitted

Table 26

Projected Computer Assisted Learning
Usage, by Academic Areas, 1980-85*

	N	%
Math	440	72.5%
Business	245	40.4%
Natural Science	244	40.2%
English, Reading and Language Arts	96	15.8%
Social Science	85	14.0%
Other	32	5.3%

* Multiple responses permitted

Table 27

Projected Computer Assisted Learning
Usage by Grade Level, 1980-85*

	N	%
10-12	441	72.7%
7-9	339	64.1%
K-6	272	44.8%

* Multiple responses permitted

Table 28

Largest Projected Computer Assisted Learning
Usage by Grade Level, 1980-85

	N	%
10-12	247	66.6%
K-6	71	19.1%
7-9	53	14.3%

anticipated to continue to be acquired from sources outside the district.

The secondary school is anticipated to continue to be the prime level for the use of computer assisted learning, although more than 50% of the districts anticipate usage at grades 7-9 and close to 50% anticipate usage at the elementary school level by 1985. As in the past,Mathematics is the largest user area followed by Natural Sciences, Business and Language Arts.

Impediments to Computer Assisted Learning Usage

Tables 29 through 34 present data in this area. Major impediments identified by school districts in regard to implementation of computer assisted learning are funding, lack of computer knowledge and lack of adequate computer learning modules. Funding is the most serious obstacle in about two-thirds of the responding districts.

Again, close to two-thirds of the respondents indicated that outside assistance would be required to change the situation. The major types of assistance felt to be helpful included funding and consultants to provide faculty training and to advise on selection and use of modules. Similarly, off-campus learning centers offering computer assisted learning services were thought to be helpful by about two-thirds of the responding districts.

Finally, in regard to overall views of impediments to be overcome for computer assisted learning to be used effectively in the districts, Table 34 identifies those write-in items in order of frequency of report by districts. Again, similar kinds of impediments were identified for effective use as for initial implementation. Thus funding was considered of primary importance, followed by lack of knowledge about computer assisted learning and computers in general, attitudes of faculty and need for more and better computer assisted learning modules.

Table 29

Impediments to Computer Assisted Learning Usage*

	N	%
Finances	499	82.2%
Lack of computer knowledge	275	45.3%
Availability of adequate programs	252	41.5%
Faculty resistance	137	22.6%
Availability of adequate hardware	134	22.1%
Other	40	6.6%

* Multiple responses permitted

Table 30

Largest Impediment to Computer Assisted Learning Usage

	N	%
Finances	350	66.9%
Lack of computer knowledge	72	13.8%
Availability of adequate programs	50	9.6%
Faculty resistance	24	4.6%
Other	19	3.6%
Availability of adequate hardware	8	1.5%

Table 31

Outside Assistance Required to Implement Computer Assisted Learning

	N	%
Outside assistance is required	351	60.1%
Outside assistance is NOT required	233	39.9%

Table 32

Type of Outside Assistance
Required to Implement Computer Assisted Learning*

	N	%
Financial	276	45.5%
Consultants to provide faculty training	233	38.4%
Consultants on selecting & using computer assisted learning programs	212	34.9%
Consultants on hardware selection	133	21.9%
Other	21	3.5%

* Multiple responses permitted

Table 33

Perceived Value of Off-Campus
Computer Assisted Learning Centers

	N	%
Not valuable	192	37.6%
Valuable only if sponsored by educational institution(s)	160	31.3%
Valuable whether funded by private sector or educational institution(s)	159	31.1%

Table 34

Impediments to be Overcome for Computer Assisted Learning to be Used Effectively in Secondary/Elementary Schools

Rank Order	Impediment
1	Finances.
2	Lack of knowledge about computer assisted learning and computers.
3	Attitudes of faculty.
4	Need for more and better computer assisted learning programs.
5	Need for more equipment.
6	Attitudes of educational decision makers.

Recommendations to the Task Force

As to the future role the Task Force might play, Table 35 indicates that school districts feel that information dissemination, especially regarding availability of quality computer assisted learning programs and sources of funding,would be considered most helpful. These recommended activities are closely followed by assistance with faculty and key administrators' training. Finally, help in acquiring and/or developing computer assisted learning courseware would be considered most beneficial.

Comparisons of Urban/Rural Districts

Current usage of computers is greater in urban school districts than in rural districts, and is projected to continue in that vein through 1985. However, since a minimum of about 85% of districts, urban and rural, indicate current computer usage, with the minimal percentage projected to rise to over 90% by 1985, such differences appear miniscule. Similarly, some differences were found to indicate that faculty in urban districts are more interested in writing computer assisted learning programs, while rural districts indicate a greater lack of computer knowledge and a greater desire for the Task Force to disseminate information on the topic. Overall, however, the profiles of the urban and rural schools were very similar.

Comparison of Districts by Geographic Area

School districts in the northeast, south, midwest and far west all showed similar patterns of response, with only slight variations. The major variations were concerned with the south. In that area there appeared to be more heavy involvement in computer assisted learning usage at the elementary level as compared to all other areas of the U.S. This involvement is projected to continue through 1985. Similarly, faculty and student response to the use of computer assisted learning seemed even more positive in the south than in other U. S. areas.

Table 35

Computer Assisted Learning Task Force Activities which Could Be of Most Service to Secondary/Elementary Schools

Rank Order	Activity
1	Disseminate information about computer assisted learning (available computer assisted learning programs, results of research in area, etc.).
2	Funding (provide information and assistance in securing federal, state & local funding to support computer assisted learning).
3	Provide in-service training
4	Serve as clearinghouse for existing computer assisted learning courseware.
5	Assist in changing attitudes of educational decision makers.
6	Assist in computer assisted learning program development (encourage faculty to write new programs and to distribute them, etc.).
7	Assist in changing faculty attitudes.

Requests for Computer Assisted Learning Materials

The desire for information in this area was amply demonstrated, in that over 60% of the districts requested informational materials and asked to be placed on the mailing list for future materials.

DISCUSSION

Discussion will focus first on the changes in the use of the computer in the secondary/elementary schools over the past twenty years. Secondly, the critical issues in the use of computer assisted learning at these educational levels will be identified. Finally, future usage and trends will be projected.

Comparison of Current and Earlier Studies

The current study, showing 90% of secondary/elementary school districts in the U. S. using a computer, is a dramatic change from the past. With the computer showing only slight increases in usage in the districts in the sixties, the seventies brought with them a near revolution in the light of an increase in instructional computer usage from an estimated 13% in 1970 to 74% in 1980. Similarly, the type of instructional usage has changed from predominately problem solving and the acquisition of EDP skills, to a much heavier emphasis upon computer assisted learning.

School districts initially implemented computer use in the instructional area via the mathematics department in the secondary schools. Although usage continues to spread to the Natural Sciences, Business and Language Arts, and continues to grow downward through the grade levels, no similar dramatic changes have taken place in these regards as contrasted to the sheer numbers of new computer users. In essence, the quantity of instructional computer usage in the secondary/elementary schools has increased significantly (and now appears accepted as a part of the educational scene), while the richness and

diversity of usage has not increased proportionately. This follows the industry trend; the majority of efforts have been placed on hardware, with resulting decreases in hardware cost and greater availability to consumers. Thus, most school districts now appear to have their own hardware, while they are woefully short of adequate computer programs to support instructional objectives. They also appear to lack adequately trained staff to enable meaningful use of the more complex computer uses as exemplified by computer assisted learning.

Critical Issues

The critical issues of the 60's and 70's in regard to secondary/elementary use of computer assisted learning, in addition to the general funding problem, were hardware and faculty/administrative resistance. Although these latter two problems appear still to be in existence, their importance have now been overshadowed. The major critical issues confronting the school districts in attempting to implement and successfully support the use of computer assisted learning today, again in addition to the overall funding problem, appear to be acquisition of quality computer assisted learning programs and lack of knowledge of how to effectively use such materials in the learning situation.

The Future of Computer Assisted Learning in U. S. Secondary/Elementary Schools

The availability of low-cost microcomputers with multi-sensory capabilities (making them ideally suited for computer assisted learning) has already been felt in the secondary/elementary schools, and is likely to play an important role in the increased use of computer assisted learning. Other signs also point toward a significant increase in the use of computer assisted learning during 1980-85, especially at the elementary and senior high levels (see Table 22).

The major obstacles to computer assisted learning's successful use -- information, faculty training, and availability of quality computer assisted learning programs -- will not be totally resolved by 1985. However, the federal government and some of the research and service oriented universities have already provided faculty expertise and other resources in support of experiments in computer assisted learning. The results of these experiments are now beginning to be felt at the secondary/elementary level in the form of reports on the use of computer assisted learning in the classroom. In addition, some computer assisted learning programs of reasonably high quality are now available (10).

In addition, cottage industries are beginning to flourish in the development of computer assisted learning programs. The best of these will likely survive and may provide the backbone of the new computer assisted learning software houses.

Finally, some of the major book publishers are now seriously considering the acquisition and/or development and sale of computer assisted learning programs for the classroom. Although such efforts are likely to be hampered by the publisher's thinking in regard to books (which will partially carry over to computer assisted learning programs), ultimately computer assisted learning programs will be recognized for their own value and treated accordingly.

These major approaches to the acquisition/development/distribution of computer assisted learning programs and to the solutions of other major computer assisted learning problems should provide the milieu in which usage at the secondary/elementary level should flourish in the 80's. It is predicted that by 1985 the current major problems in the use of computer assisted learning will have been reduced to the level that the hardware problem has now reached in 1980. Further, it is predicted that by 1990, learning with the aid of computers will

be general at all grade levels and in most educational fields. The type of usage will have shifted from drill and practice to tutorials by 1985, and perhaps towards simulations by 1990. Personal computers will be the principal mode of delivery of computer assisted learning in the schools. Finally, learning centers, using personal computers with access to data bases on large computers housed in central areas such as public libraries, will provide service in downtown and other off-school areas to adults wishing to continue their education outside of the normal learning environment.

SUMMARY AND RECOMMENDATIONS

Summary

The study reported here was undertaken by the Task Force on Computer Assisted Learning of the ACM's Sub-Committee on Computing in the Secondary/Elementary Schools.

The primary purpose of the study was to assess the current and projected use of the computer in U. S. public secondary/elementary schools, with special emphasis on the use of the computer in computer assisted learning. A part of this overall assessment was to determine factors impeding the use of computer assisted learning so that guidelines could be established to facilitate its use.

A sample of 974 school districts was selected to most closely approximate the total population of U. S. public school districts. The district superintendents were contacted through a personal letter and a 34 item questionnaire, in March, 1980. The letter encouraged superintendents to identify a person on their staff to complete the questionnaire and to serve as a future computer assisted learning coordinator. A portion of the questionnaire was devoted to a description of various computer assisted learning publications and programs which the districts could receive free of charge.

A total of 62.3% of the school districts completed and returned the questionnaires. Analyses of the data revealed the following:

1) In 1980, the percentage of school districts using the computer for instructional and/or administrative purposes stood at 90%. It is projected to rise to 94% by 1985.
2) Between 1970 and 1980, the best estimates of instructional usage of the computer showed increases from 13% in 1970 to 74% in 1980. Instructional usage is anticipated to reach 87% of the districts by 1985.
3) Computer assisted learning is currently in use in 54% of the districts, and represents the type of usage reported by the second largest number of districts.
4) Heaviest usage of computer assisted learning is in the nation's secondary schools. The Mathematics departments show the largest usage, followed by the Natural Sciences, Business, and Language Arts.
5) Most computer assisted learning programs in use in the districts are written in BASIC, were acquired from outside the district, are predominately drill and practice, and run on a variety of large, mini and microcomputers.
6) Secondary/elementary faculty and students give computer assisted learning a high rating.
7) Projections for 1980-85 indicate computer assisted learning will be used by more school districts than any other type of computer application. Usage is anticipated to rise from 54% of the districts to 74%.
8) Type of computer assisted learning usage is predicted to shift from the current emphasis on drill and practice to tutorials by 1985, and ultimately to simulations.

9) Microcomputers are anticipated to play an increasingly significant role in computer assisted learning usage in the school districts.

10) Computer assisted learning usage is projected to continue to be heavy in Mathematics, Natural Sciences, Business, and Language Arts at the secondary level, while also expanding to more significant usage at other relevant high school fields such as Social Sciences. More extensive use is also anticipated at the elementary level.

11) Major impediments to implementation and successful use of computer assisted learning at the secondary/elementary level appear to be financial, lack of knowledge about computer assisted learning and computers, attitudes of faculty, and need for more and better computer assisted learning programs.

12) Major computer assisted learning Task Force activities felt to be helpful by the districts were identified as dissemination of information about computer assisted learning in general and about computer assisted learning funding sources, providing in-service training for faculty, and serving as a clearinghouse for existing computer assisted learning courseware.

Recommendations

In the light of the results of the current study and the authors' experiences, the following recommendations are offered:

1) School districts not now using computer assisted learning should appoint a coordinator to acquire relevant information and to assist in general with the implementation of pilot computer assisted learning projects.

2) School districts now using computer assisted learning should disseminate relevant information throughout the districts concerning the results of the use of computer assisted learning nationwide as well as the specific results of local projects. Training programs for faculty should be implemented. Liaisons with local higher education institutions and state departments of education should be formed to make use of faculty expertise as consultants and to develop joint funding proposals for submission to federal, state, and/or private agencies.

3) Major government agencies and private foundations should support information dissemination and consulting proposals to assist U. S. secondary/elementary schools to implement and successfully use computer assisted learning. In addition, these agencies should fund proposals to increase the quantity and quality of computer assisted learning programs.

4) The private sector, particularly computer vendors and publishing firms, should form cooperative agreements with secondary/elementary schools and institutions of higher education to help ensure that computer assisted learning programs developed in the future are of higher quality, and are disseminated widely at reasonable costs.

ACKNOWLEDGEMENTS

The authors wish to thank Mr. David Applegate, U. C. Berkeley, and Mrs. Gail Austin and Mr. Jerry W. Sprecher, both of CSU, Fresno, for their assistance in the design and implementation of this study.

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